(12) UK Patent Application (19) GB (11) 2 284 952 (13) A

(43) Date of A Publication 21.06.1995

(21) Application No 9421765.0

(22) Date of Filing 28.10.1994

(30) Priority Data
(31) 9324265 (32) 25.11.1993 (33) GB

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(51) INT CL[6]
H05B 37/03 , G08B 26/00 // H05B 37/02

(52) UK CL (Edition N)
H2K KJBC KSA9 K252 K453 K545
U1S S1932

(56) Documents Cited
GB 2174852 A GB 1494240 A EP 0582287 A2
EP 0470034 A2 WO 92/16086 A1 WO 90/04242 A1

(58) Field of Search
UK CL (Edition N) G1U UR19165 UR3124 UR3144 ,
H2K KHA KJBC KSA1 KSA2 KSA9
INT CL[6] G01R 19/165 31/24 31/44 , H05B 37/03
Online : wpi, japio, edoc

(54) Remote control and monitoring of lighting

(57) Control and monitoring of lamps 1 in a lighting system is provided. The lamps are remotely connected and disconnected to an electrical supply 8 as required. Current consumed by a lamp or group of lamps is measured 3, 4 locally. Remote interrogation of each current measuring means and comparison with the expected current use allows identification of the operation of each lamp or groups of lamps. Significant drops in the current indicate failure or malfunction. Each current m asuring means may be provided with a unique address for individual polling by an interrogation signal. Interrogation is performed by signals transmitted by a remot management centre 10, 12 over a mains signalling interface 7A. Master unit 10 pulls each lamp continually at a predetermined rate.

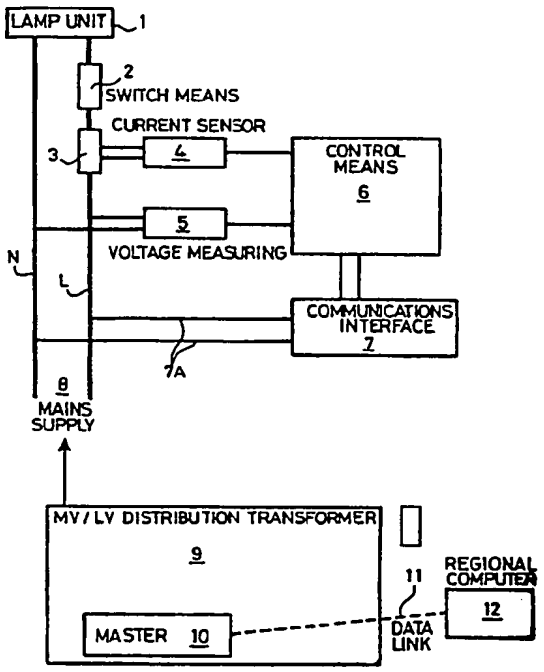

Fig. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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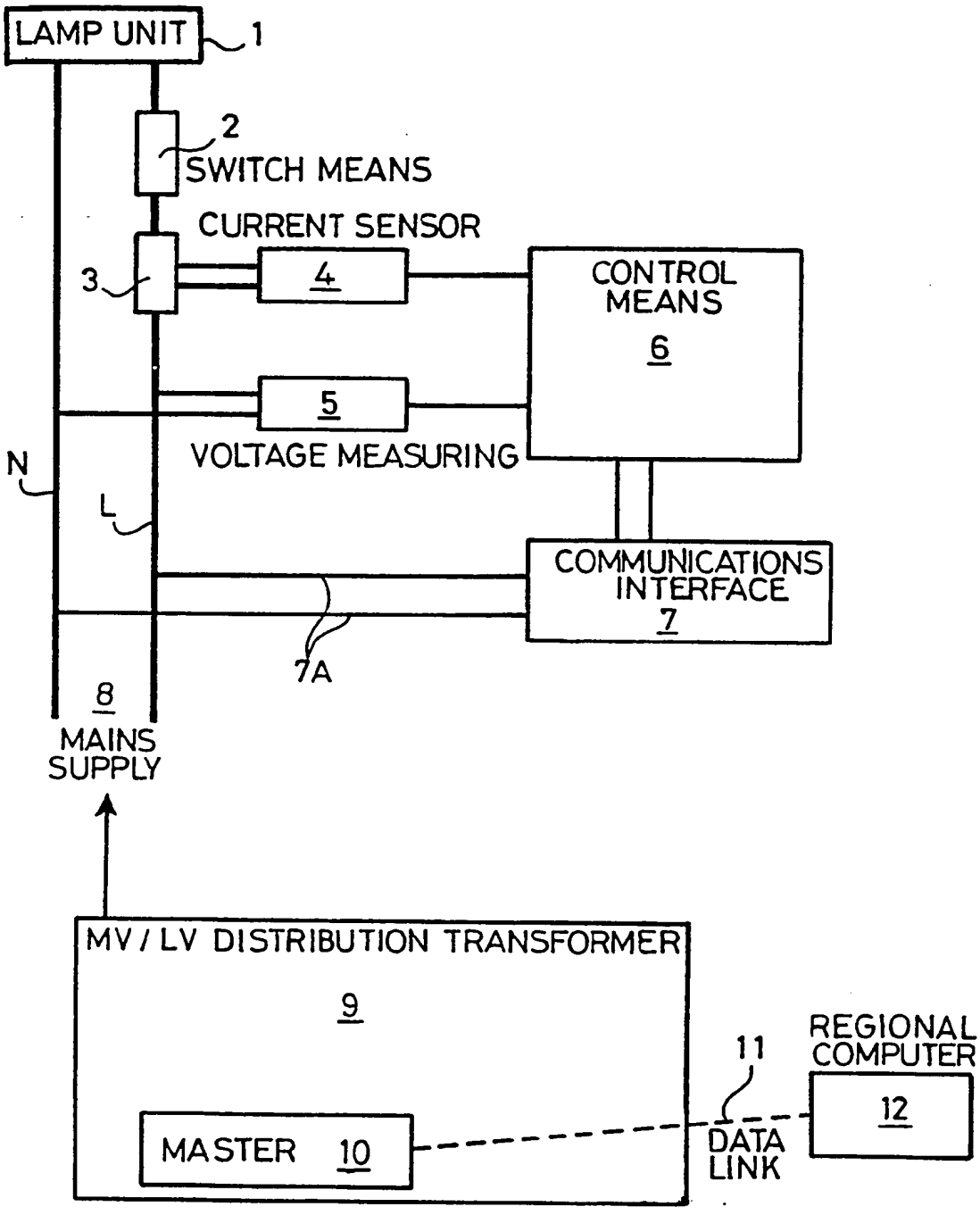

Fig. 1

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Title: Remote Control of Lighting

Field of Invention

The present invention concerns a method of and apparatus for controlling the status of lighting, particularly by the use of two-way communications media, such as by distribution line communication or by radio communication.

Background to the Invention

Where artificial lighting is provided there is a need to control and monitor the status of such lighting. The lighting provided may be for the illumination of roads, streets, motor ways, or anywhere that requires illuminating during periods of darkness, whether temporarily or permanently.

Lighting may be remotely switched by time switches, by "ripple control" or automatically using light sensors associated with the lighting units.

If the operation of individual lights is to be monitored, such as whether a fault condition exists or not, a visit is required by an authorised person so that the installation can be inspected. This is expensive and time consuming.

A System for the control of street lighting is known from the paper entitled "The centralized control system for street lighting" submitted to the CIBSE National Lighting Conference 1990. This system allows for remote control of a lighting network, with commands issued from a central controller to control the lamps. No remote interrogation of the lamps on demand is disclosed.

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It is an object of the present invention to provide a remote control system for remotely switching and monitoring the operation of lights in a lighting system in which, the lights can be remotely interrogated as required.

Summary of the Invention

According to one aspect of the present invention a method of controlling and monitoring the operation of lamps in a lighting system comprises the steps of:-
(a) remotely connecting and disconnecting lamps to an electrical supply system, as required;
(b) locally measuring the current consumed by a lamp or group of lamps, and retaining a signal indicative of the current flowing thereto;
(c) remotely interrogating each current measuring means and transmitting to a management centre the retained current signals therefrom; and
(d) retaining in said management centre signals indicative of the switched status of each lamp or group of lamps and the current signals associated therewith.

By comparing the current signal value with the expected current to be drawn when each lamp or group of lamps is connected to the supply, so the operation or other use of each lamp (or group of lamps) can be ascertained.

If the supply voltage is constant and any supply line volt drop can be disregarded, the power consumed by each lamp or group of lamps can be computed from the known voltage and the measured currents drawn.

Alternatively, and preferably, the voltage across the lamp or lamps may be measured locally and a further signal whose value relates to the measured voltage retained and may be transmitted

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following interrogation to the management centre, so that a more accurate value of power consumed per lamp or group of lamps can be computed.

It will be noted that if the current drawn is significantly less than expected for any lamp or group of lamps, a failure or malfunction of a lamp or one or more of a group of lamps is indicated.

According to a preferred feature of the invention each local measuring means is provided with a unique address by which it can be individually polled by an interrogating signal and which can if desired be transmitted by it with the current signal (and if measured the voltage signal) so as to identify the lamp or group of lamps to which the current signal (and voltage signal if measured) relates, so that the power of each lamp (or group of lamps) can be uniquely identified at the management centre. By listing the unique addresses to the measured current (and voltage) signals, so the precise geographical location of any failed or malfunctioning lamp or group of lamps can be determined using for example location data stored in a look-up table or the like.

A mimic diagram may be employed at the management centre and a fault condition at any location may be revealed by a warning light flashing (or other visually distinguishable feature) at the appropriately marked position in the mimic diagram.

A computer display screen, or bank of computer display screens may be employed to display the locations of the lamps or group of lamps in a system.

At the management centre, a fault condition will show precisely where the problem lies, allowing personnel to go directly to the problem location.

The interrogation of the measuring means, and the transmission

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of interrogating signals and measured/retained value signals, may be effected in any known manner as by modulation of an electrical supply current, or by radio transmission or radio telephoning or any combination thereof.

The interrogation may be performed by signals transmitted from the management centre, or by signals transmitted from intermediate control centres themselves adapted to retain data signals obtained from the measured values transmitted from the interrogated measuring means together with data identifying the lamps or groups of lamps to which the different data signals refer, for onward transmission to the management centre when called for.

As before stated the transmission of signals for intermediate control centres may be by any known method such as aforesaid.

The switching on and off of the lamps and/or group of lamps may be effected from the management centre or from one or more different management centres.

Signals for controlling the switching of the lamps or group of lamps may be transmitted by any known method such as aforesaid.

The invention also lies in apparatus for performing the methods as aforesaid.

Typically each local measuring means and local switching means includes an interface for permitting two-way signalling and data signal transmission.

The switch means is preferably also under control of the control means.

The control means may have a communications interface for providing a two-way communications media. The communications media may be provided by a distribution line or by radio

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communication.

Description of Embodiment

An embodiment of the invention will now be described, by way of example only, with reference to Figure 1 of the drawings, which shows a remote control installation using mains signalling as the communication method for controlling artificial lighting.

A lamp 1 is supplied with electrical power from a mains supply 8, the live wire L of the incoming supply being fed to the unit via a current meter 3 and a switch 2. The neutral wire N is connected directly to the lamp unit. The current meter 3 and switch 2 could alternatively be connected in the neutral wire of the supply.

The meter 3 is connected to a sensor 4 which together form a current measuring means capable of measuring current flowing from the supply 8 to the lamp 1. This measuring means can be of any accuracy as required. The output from the sensor 4 is a signal representative of the current flowing to the lamp which is fed to a control 6.

A voltmeter 5 is connected across the live and neutral wires N and L for measuring the voltage of the incoming supply 8 across the lamp. The output from the voltmeter 5 provides a signal representative of the measured voltage and is also fed to the control 6.

The switch 2 is provided for switching the lamp on and off according to a command signal from the control 6. Where there are multiple lamps in a single lamp-standard, there may be one switch associated with each lamp.

A communication interface unit 7 provides for the reception and transmission of command signals and data exchange with the

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control 6 and a master controller. In this example a mains signalling interface 7A is shown connected across the supply 8. Each lamp-standard will have its own interface 7 and unique address.

At a medium voltage/low voltage (mv/lv) distribution transformer 9, or at any other convenient location on a distribution network, there is located a master communication interface 10 which is capable of communicating with individual lamp-standards for the control, and monitoring the status, of the lamps. Where multiple phases are employed the master unit 10 is connected to all the phases of the supply (typically three) so that it communicates with any lamp connected to its supply network, whichever phase the lamp may be connected to.

Located remotely from the master unit 10 is a regional computer 12 connected by a communication data link 11, such as a radio or a telephone line. The regional computer can communicate with and control a plurality of master units 10.

The apparatus described above operates as follows:-

An authorised person from, for example, a lighting utility company instructs the computer 12 to switch on the lights in a given location. (Alternatively this may be achieved automatically by a computer program). This will be accomplished by the computer 12 establishing communication with one or more master units 10 and instructing each to turn on the lamp(s) under its command.

For example each master unit 10 can communicate with each lamp-standard individually, or may issue a general broadcast message to all of its lamp-standards simultaneously, to instruct them to switch on the lamps via the mains signalling interface 7A, the control means 6 and switch 2.

It may be desirable to stagger, in time, the switching on of

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lamps so as to limit the instantaneous power demand on a distribution network.

The master unit 10 polls the individual lamps or lamp-standards continually at a predetermined rate in order to monitor their status and to check for a fault condition. For example, if a lamp has been instructed to be switched on, the current measuring means 3 and 4, which continually measures the current flowing to the lamp, can ascertain if the lamp is conducting. If for any reason no current is flowing during the next poll of the lamp, the control means 6 can inform the master unit 10 of the fault. The master can then in turn inform the regional computer 12 of the failure and, by virtue of its unique address, its location.

The voltmeter 5 also continually monitors the voltage of the supply 8. The control means 6 being supplied with signals, representative of both voltage and current, can then compute the energy consumed by the lamp. This value can be reported to the regional computer 12 for electricity billing.

Where there are multiple lamp units 1 in a lamp-standard it is possible to have a switch and a current measuring means for each lamp unit, although it is more likely that there will be a single current measuring means for all the lamps and an individual switch for each lamp.

With an individual switch for each lamp, it is possible to have a lighting management regime that allows switching on or off of individual lamps within a multi-lamp lamp-standard, thereby enabling the saving of energy.

It is also possible to measure the average current and compare this with known ranges of values of current, to determine whether one or more of the lamps have failed.

Such a management regime can also cater for the switching off

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of individual lamp-standards on an ad-hoc basis, to reduce energy consumption as local conditions allow.

An artificial lighting control as described can be used with any energy source, where the energy source is locally controllable to each lamp or group of lamps, and where the energy consumption can be measured and two-way communication can be established between a local control unit for each lamp or group of lamps and a remote signalling and receiving unit.

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Claims

1. A method of controlling and monitoring the operation of lamps in a lighting system comprising the steps of :-
(a) remotely connecting and disconnecting lamps to an electrical supply system, as required;
(b) locally measuring the current consumed by at least one of a plurality of lamps, and retaining a signal indicative of the current flowing thereto;
(c) remotely interrogating each current measuring means and transmitting to a management centre the retained current signals therefrom; and
(d) retaining in said management centre signals indicative of the switched status of at least one of a plurality of lamps and the current signals associated therewith.

2. A method according to claim 1, wherein the current signal value is compared with the expected current to be drawn when at least one of a plurality of lamps is connected to the supply, so the operation or other use of at least one of a plurality of lamps can be ascertained.

3. A method according to claim 1 or claim 2, wherein the power consumed by at least one of a plurality of lamps is computed from a known supply voltage and the measured current drawn by the lamp or lamps concerned.

4. A method according to claim 1, 2 or 3, wherein the voltage difference across at least one of a plurality of lamps is measured locally and a further signal whose value relates to the measured voltage difference is retained and is transmitted following interrogation to the management centre.

5. A method according to any of claims 1 to 4, wherein each

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local measuring means is provided with a unique address by which it can be individually polled by an interrogation signal and the address is transmitted by it with at least one of the measured current signal and the measured voltage signal so as to identify at least one of the plurality of lamps to which at least one of the current signal and voltage signal relates, so that the power of at least one of a plurality of lamps is uniquely identified at the management centre.

6. A method according to any of claims 1 to 5, wherein a mimic diagram is employed at the management centre and a fault condition at a location is revealed by a visually distinguishable feature at an appropriately marked position in the mimic diagram.

7. A method according to any of claims 1 to 6, wherein at least one of a plurality of computer display screens is employed to display the locations of at least one of a plurality of lamps in a system.

8. A method according to any of claims 1 to 7, wherein the interrogation is performed by signals transmitted from the management centre.

9. A method according to claims 1 to 8, wherein interrogation is performed by signals transmitted from intermediate control centres adapted to retain data signals obtained from the measured values transmitted from the interrogated measuring means together with data identifying at least one of the plurality of lamps to which the different data signals refer, for onward transmission to the management centre when called for.

10. A method according to any of claims 1 to 9, wherein interrogation of the measuring means, and the transmission of signals, is effected in any known manner as by modulation of an electrical supply current, or by radio transmission or radio

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telephony or any combination thereof.

11. A method according to any of claims 1 to 10, wherein a switch means for switching on and off of at least one of a plurality of lamps is provided so that switching is effected from at least one of a plurality of management centres.

12. A method according to claim 11, wherein each local measuring means and switching means includes an interface for permitting two-way signalling and data signal transmission.

13. A method according to claim 11 or claim 12, wherein a switch means for switching on and off at least one of a plurality of lamps is under control of the intermediate control centre.

14. A method according to any of claims 1 to 13, wherein the control means has a communications interface for providing two-way communication.

15. Apparatus for performing any of the methods of claims 1 to 14.

16. Apparatus and methods for control and monitoring of a lighting system substantially as herein described with reference to and as illustrated in the accompanying drawings.

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Amendm nts to the claims hav been filed as follows

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Claims

1. A method of controlling and monitoring the operation of lamps in a lighting system comprising the steps of :-
(a) remotely connecting and disconnecting lamps to an electrical supply system, as required;
(b) locally measuring the current consumed by at least one of a plurality of lamps, and retaining a signal indicative of the current flowing thereto;
(c) remotely interrogating each current measuring means and transmitting to a management centre the retained current signals therefrom; and
(d) retaining in said management centre signals indicative of the switched status of the said at least one lamp and the current signals associated therewith.

2. A method according to claim 1, wherein the current signal value is compared with the expected current to be drawn when said at least one lamp is connected to the supply, so that the operation or other-wise of the said at least one lamp can be ascertained.

3. A method according to claim 1 or claim 2, wherein the power consumed by said at least one lamp is computed using the known supply voltage and the measured current drawn by the lamp concerned.

4. A method according to claim 3, wherein the computed power value is used in the management centre for customer billing.

5. A method according to claim 1, 2, 3 or 4, wherein the voltage difference across said at least one lamp is measured locally and a further signal whose value relates to the measured voltage difference is retained and is transmitted

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following interrogation to the management centre.

6. A method according to any of claims 1 to 5, wherein a plurality of local measuring means is provided each having a unique address by which it can be individually polled by an interrogation signal, and the address is transmitted together with at least the measured current signal so that the power consumed by each of a plurality of lamps is uniquely identified at the management centre.

7. A method according to any of claims 1 to 6, wherein a mimic diagram is employed at the management centre and a fault condition at a location is revealed by a visually distinguishable feature at an appropriately marked position in the mimic diagram.

8. A method according to any of claims 1 to 7, wherein at least one of a plurality of computer display screens is employed to display the locations of a plurality of lamps in a system.

9. A method according to any of claims 1 to 8, wherein the interrogation is performed by signals transmitted from the management centre.

10. A method according to claims 1 to 9, wherein interrogation is performed by signals transmitted from intermediate control centres adapted to retain data signals obtained from the measured values transmitted from the interrogated measuring means together with data identifying the lamp to which the different data signals refer, for onward transmission to the management centre when called for.

11. A method according to any of claims 1 to 10, wherein interrogation of the measuring means, and the transmission of signals, is effected in any known manner as by modulation of an electrical supply current, or by radio transmission or radio

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telephony or any combination thereof.

12. A method according to any of claims 1 to 11, wherein switch means for switching on and off of at least one of a plurality of lamps is provided, which switch means is operable by control signals from a management centre.

13. A method according to claim 12, wherein a management centre controls the switching on and off of a plurality of lamps so as to stagger the switching over a period of time so as to limit the magnitude of changes in instantaneous power demand in the system.

14. A method according to claim 12 or 13, wherein each local measuring means and switching means includes an interface for permitting two-way signalling and data signal transmission.

15. A method according to any of claims 12, 13 or 14, wherein a switch means for switching on and off at least one of a plurality of lamps is under control of an intermediate control centre.

16. A method according to any of claims 1 to 15, wherein the control means has a communications interface for providing two-way communication.

17. Apparatus for performing any of the methods of claims 1 to 16.

18 Apparatus and methods for control and monitoring of a lighting system substantially as herein described with reference to and as illustrated in the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report) 15

Application number
GB 9421765.0

Relevant Technical Fields

(i) UK Cl (Ed.N) H2K (KHA, KJBC, KSA1, KSA2, KSA9)
G1U (UR19165, UR3124, UR3144)

(ii) Int Cl (Ed.6) G01R (19/165, 31/24, 31/44) H05B (37/03)

Search Examiner
D C Brunt

Date of completion of Search
19 January 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE : WPI, JAPIO, EDOC

Documents considered relevant following a search in respect of Claims :-
1-16

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2174852 A	(TANN) see Figure 4	1,2,4,5, 8,10,11, 12,14,15
X	GB 1494240	(BOSCH) whole document, especially Figure 6	1,2,4,5, 8,10,11,12, 14,15
X,P	EP 0582287 A2	(SMEASIT) 9 February 1994, whole document	1,2,4,5,8, 10,11,12, 14,15
X	EP 0470034 A2	(INGENIERIA) whole document, especially column 5 lines 16-19 and column 9 lines 14-19	1-5,8-15
X	WO 92/16086 A1	(INDUSTRIAL CYBERNETICS) whole document	1,2,5-15
X	WO 90/04242 A1	(SWEDISH AIRPORT) whole document, especially page 7 line 35 to page 8 line 3	1,5-15

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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